

# Assessing Aquatic Habitat Quality in Restored Arroyos at Rio Mora National Wildlife Refuge

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## Abstract

Arroyos in the Southwest are common land features that are highly erosive, leading to reduced ecosystem productivity via loss of topsoil and diminished water tables. In the face of climate change, these erosive features are expected to form at higher frequencies and deteriorate exponentially. Arroyo restoration at Rio Mora National Wildlife Refuge in Watrous, New Mexico, provides a case study where these degraded systems are restored into viable habitat. Through the building of grade control structures, erosive water flows are reduced and soil deposits serve as water reserves, recharging the water table and encouraging vegetation recolonization. These structures facilitate pool formation, thus creating aquatic habitat in an otherwise xeric environment. Two arroyos undergoing restoration were selected for this project and biological and physiochemical components were measured in study pools in Petroglyph Canyon (N = 10) and Loma Parada Canyon (N = 8) during six-month summer periods in 2015 and 2016. Pools created by grade control structures were mostly ephemeral. As a result of extended water availability in degraded arroyos through grade control structures, terrestrial habitat was created, providing refuge for aquatic and terrestrial wildlife. These structures appear to facilitate the recovery in these degraded systems.

## Introduction

- Arroyos are highly erosive land features in the Southwest.
- Causes of erosion include overgrazing, human impact, drought, or changes in land use.
- Riparian systems are on the decline; 75-80% of vertebrate species depend on wetlands.
- Grade control structures are used in arroyo restoration to capture sediment and reduce flow velocities.

## Question

Is the use of one-rock dams in arroyo restoration creating viable aquatic habitat for native species?

## Objectives

- Determine the diversity and functional feeding groups of aquatic insects found in pools.
- Determine water quality and physiochemical composition of pools.
- Determine changes in relative pool volume during seasonal fluctuations.

## Study Site

The Rio Mora National Wildlife Refuge (NWR) is located in Watrous, NM (W 105.031138 N 35.50186). The refuge is a 4,224 acre piece of land that was donated to the U.S Fish and Wildlife Service in 2012. The property has a diverse of habitat including grasslands, and riparian habitat along five miles of the Mora River. To date, almost 200 grade control structures have been built in four arroyos located at the Rio Mora NWR. Two of the restored arroyos, Loma Parada Canyon and Petroglyph Canyon will be used to conduct my study (Figure 1). 10 pools were selected from Petroglyph Canyon and eight were chosen from Loma Parada Canyon.

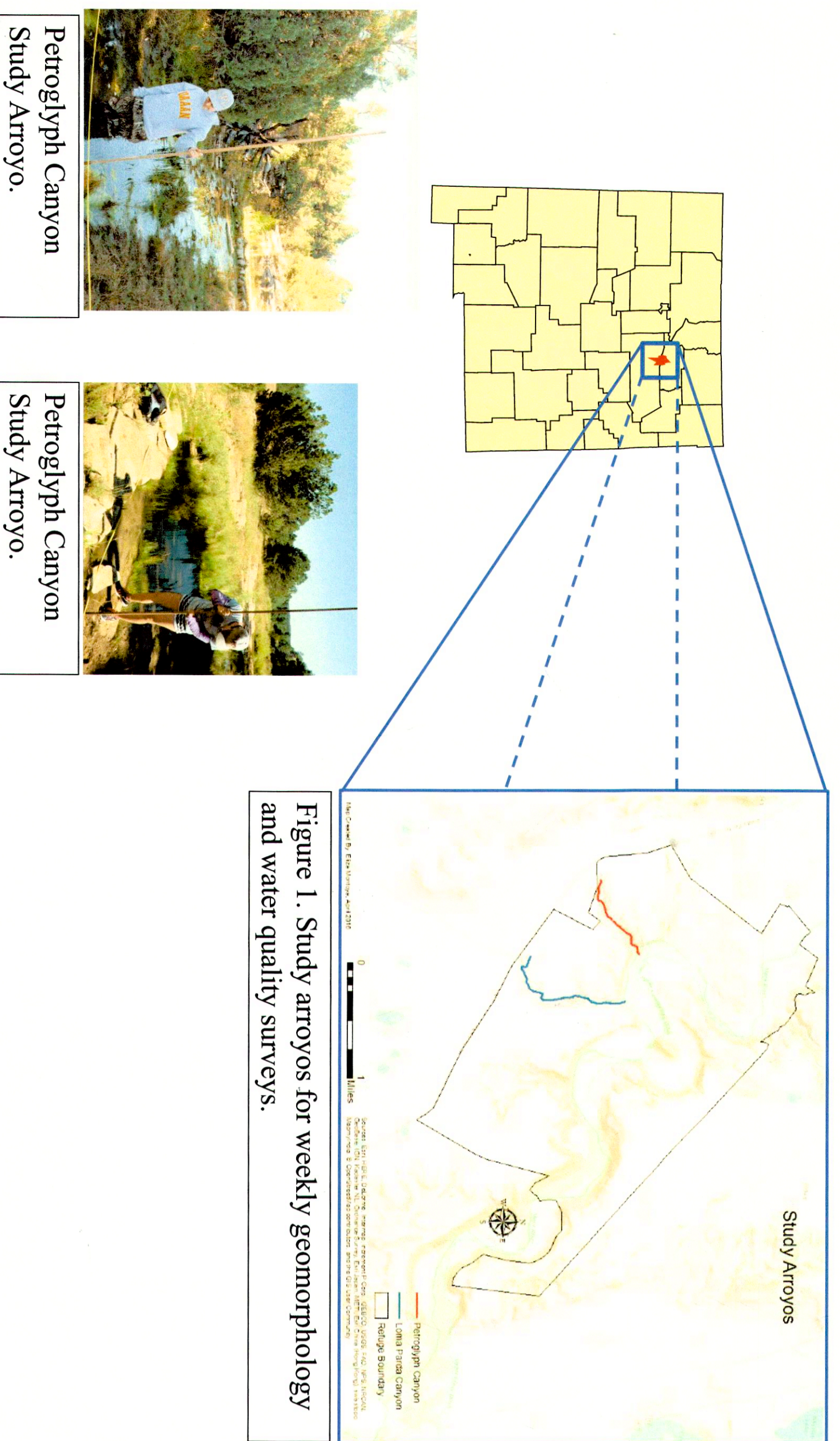


Figure 1. Study arroyos for weekly geomorphology and water quality surveys.

## Methods

### Field Work: Relative Volume

- Length, width, and depth were measured in order to calculate relative volume during seasonal fluctuations.

### Laboratory Analysis: Relative Volume

- Excel spreadsheets are added to a new map in ArcMap 10.4.1.
- A polygon is created around the pool where depth measurements were taken.
- The spline tool is used to interpolate depths between known points.
- Relative volume is calculated using the 3-d analysis tool, surface volume.



Figure 2. Weekly pool morphology surveys were completed by measuring the width, length, and depth of each study pool.

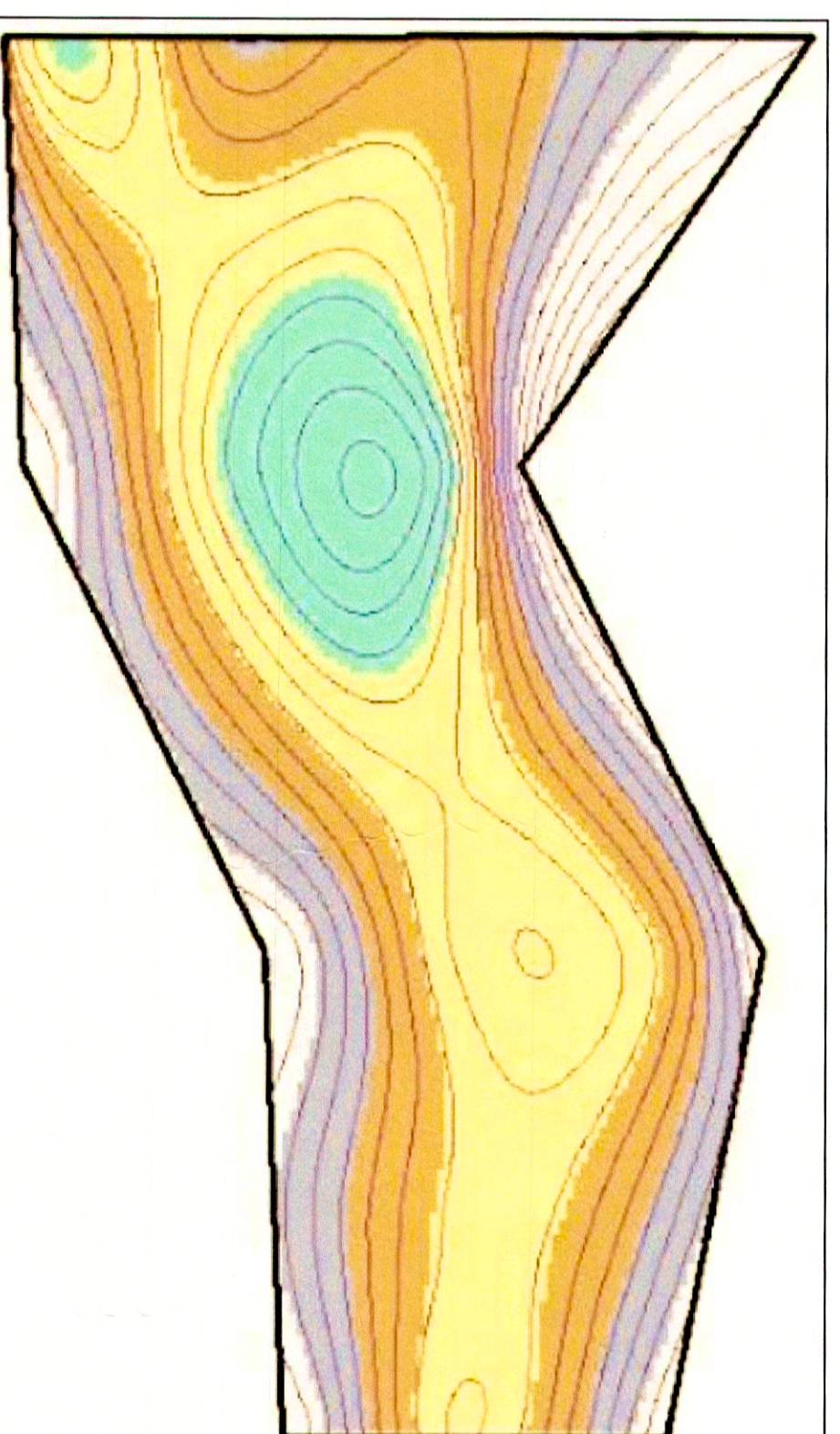


Figure 3. Study pool spline image created in ArcMap 12.2.2.

## Results

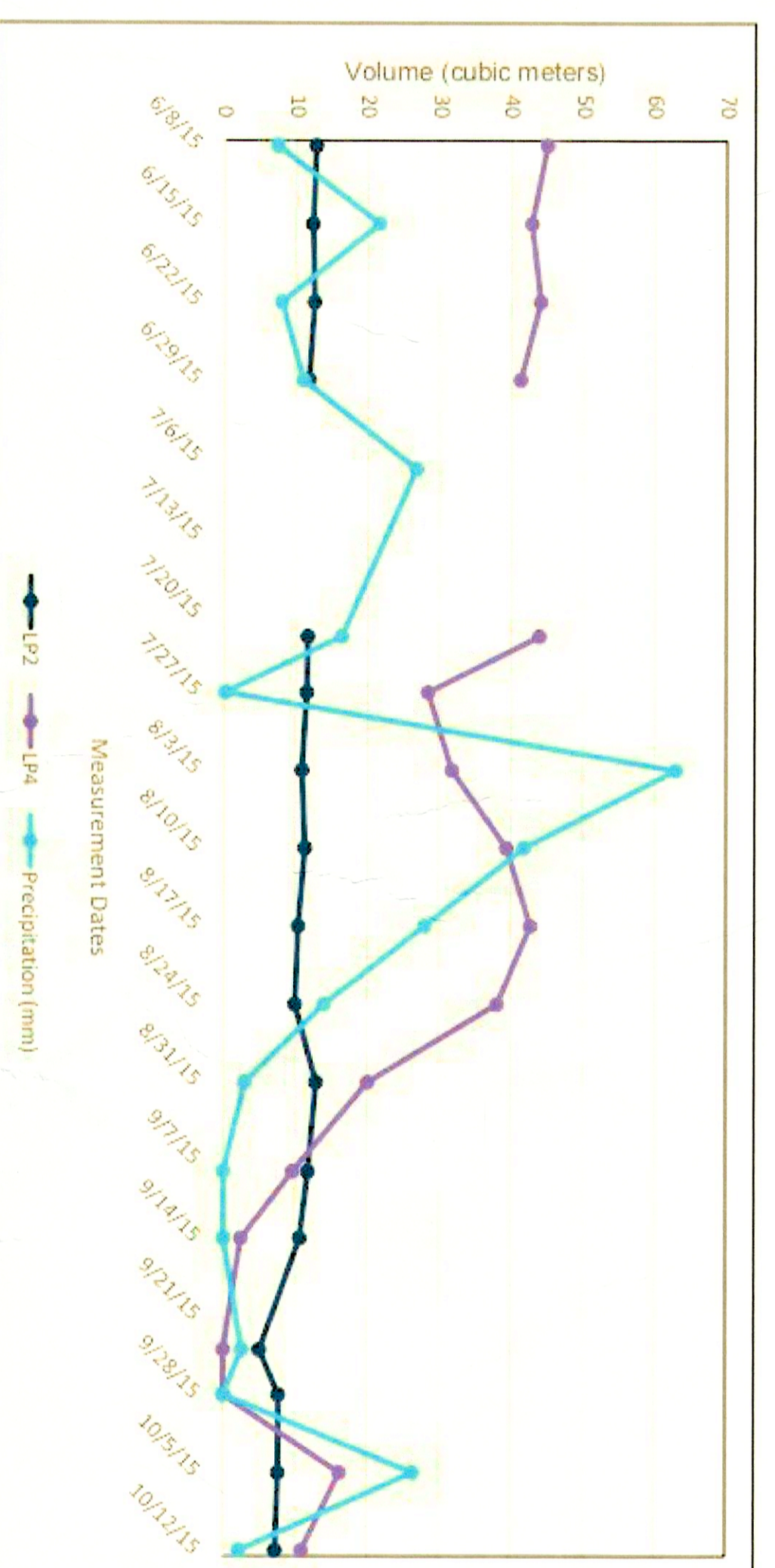


Figure 2. 2015 Relative volume (m<sup>3</sup>) measured at Loma Parada from LP2 and LP4 study pools, Rio Mora NWR, NM and weekly precipitation measurements in Loma Parada.

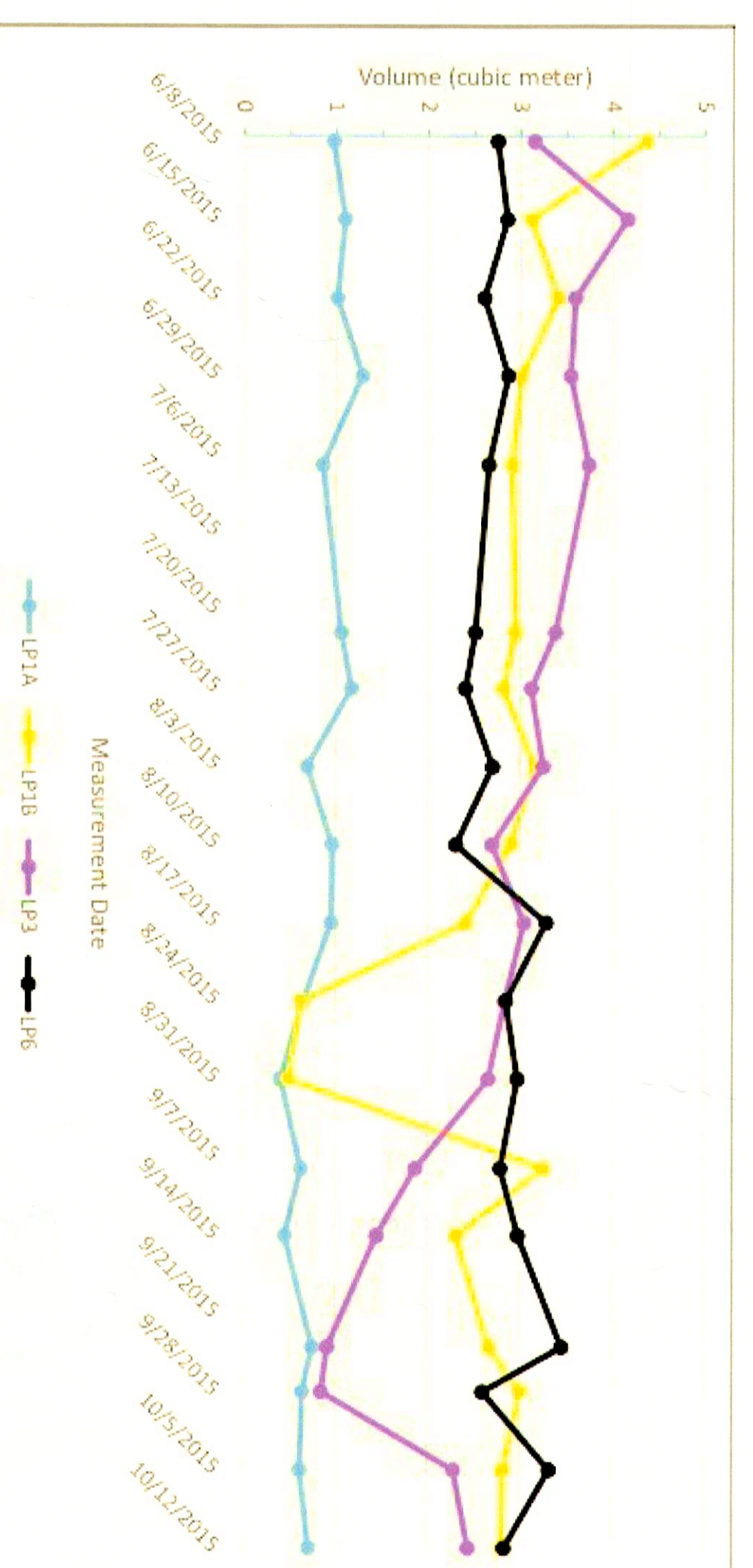


Figure 3. 2015 Relative volume (m<sup>3</sup>) measured at Loma Parada from LP1A, LP1B, LP3 and LP6 study pools, Rio Mora NWR, NM.

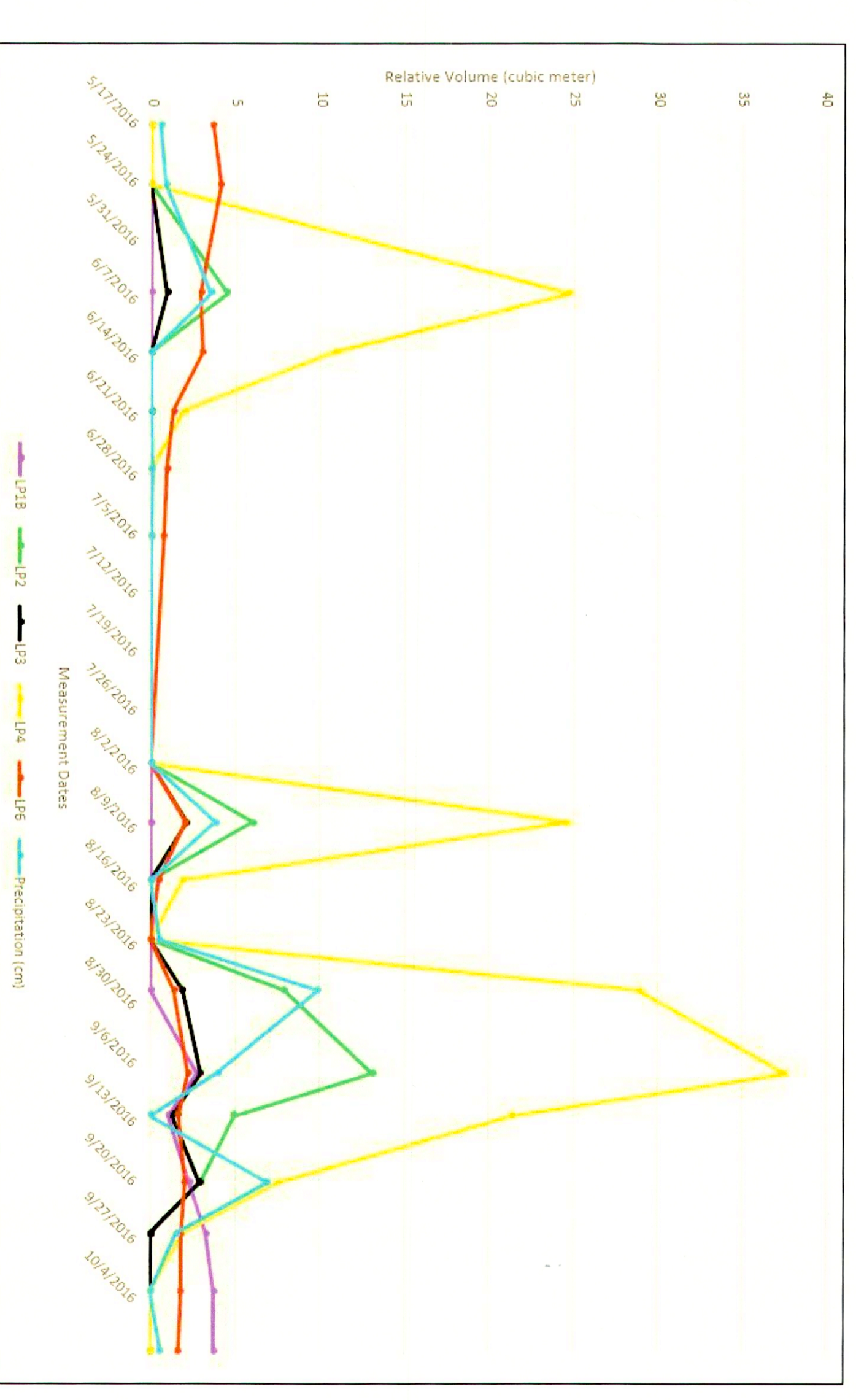


Figure 5. 2016 Relative volume (m<sup>3</sup>) measured at Loma Parada from, LP1B, LP2, LP3, LP4 and LP6 study pools, Rio Mora NWR, NM.

## Discussion

Pools created by grade control structures were mostly ephemeral. In large study pools (>5 m<sup>3</sup>) during 2015, relative volume was consistent. However, during a five-week dry period (8/31/2015-9/28/2015), large study pools experienced a decrease in relative volume. One large study pool (LP4) completely dried out during this period. Smaller study pools (<5 m<sup>3</sup>) had more fluctuations in relative volume throughout the 2015 sampling season. These smaller pools did not dry out during the five-week dry period. LP1A did not hold any water during the 2016 season due to being filled in with sediment when the dam above blew out in 2015.

During the 2016 season, we saw longer dry periods than the previous year. This resulted in the loss of more water and every pool was dry at some point during the sampling season. LP6 relative volume was consistent for the duration of the 2016 season. In 2015, we didn't see a big correlation between relative volume and precipitation events. However, in 2016 there is a clear correlation between relative volume and precipitation events. Loma Parada arroyo is fed via precipitation events and sub-surface flow from stock ponds above the study pools. This can contribute to higher relative volume for longer periods of time. As a result of extended water availability in degraded arroyos through grade control structures, terrestrial habitat was created, providing refuge for aquatic and terrestrial wildlife. These structures appear to facilitate the recovery in these degraded systems.

## Significance

- This study could identify the impact of restoration efforts on key variables.
- Contribute to the refinement of restoration design and implementation.
- Inform wildlife habitat use in newly created rehabilitated habitat.

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